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# PATENT SPECIFICATION

DRAWINGS ATTACHED

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## COMPLETE SPECIFICATION

### Improvements in or relating to Air Conditioning Systems for Aircraft

We, NORMALAIR LIMITED, of West Hendford, Yeovil, in the County of Somerset, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an air conditioning system for use particularly, although not exclusively, in aircraft of the passenger carrying type, and more particularly, although not exclusively, to aircraft of the type that operate at high altitudes and at speeds considerably in excess of the speed of sound.

In a passenger aircraft containing, say 150 passengers, a considerable quantity of CO<sub>2</sub> and of body odours will be produced during a flight. It is, therefore, necessary to remove the CO<sub>2</sub> and the odours continuously, in order to reduce their concentration to an acceptable level. This is done normally by flushing the fuselage continuously with a flow of fresh air, taken from outside the aircraft, of at least 1 lb./min./person, even when there is a considerable degree of internal recirculation of the air. The provision of this flow of fresh air taken from the outside involves a considerable loss of power and the penalty of high weight of equipment and aerodynamic drag, and it is with this problem in mind that this invention seeks to provide a system whereby the fresh air flow into the cabin is reduced by an amount greater than has hitherto been achieved. By "air" we mean breathable atmosphere from the ambient air, although it may differ slightly in gaseous proportion from the ambient air.

By reducing the intake of fresh air, the invention seeks to reduce the problems associated with known means for supplying occupants of an aircraft with pressurised air from an ambient source. Among such problems are aerodynamic drag, the weight of the necessary equipment, and power losses.

[Price 4s. 6d.]

According to the invention there is provided an air conditioning system for an enclosure of an aircraft, comprising a first conduit means for conducting ambient air to the enclosure, heat exchange means for cooling the air passing to the enclosure, the heat exchange means comprising part of the circuit of a cooling system, a second conduit means for recirculating air from the enclosure and conjoining with the first conduit means upstream of the heat exchange means, a third conduit means branching from and returning to the second conduit means and providing means for removal of odours and carbon dioxide from a portion of the air recirculating through the second conduit, a first fan means in the second conduit for urging recirculation of the air, and a second fan means in the third conduit means to urge therethrough the portion of the air.

A preferred embodiment of the invention will now be described by way of example with reference to the accompanying drawing, the single figure of which is a diagram of an air conditioning system in accordance with the invention.

Referring to the drawing, an air conditioning system for an enclosure of an aircraft includes a source of fresh air 1 conveniently bled from one or more compressors of the aircraft engines. This air passes through a heat exchanger 2, where it is cooled by air or fuel as generally indicated at 3. The cooled air is then split into three streams 4, 5 and 6, one stream 4 of which is connected to a recirculatory system for the aircraft enclosure at 14, while the other two streams 5 and 6 are led off to drive turbines 7 and 8 respectively.

Turbine 7 drives a gas recirculating fan 9 and the turbine 8 drives a pair of compressors 10 and 11 in a refrigeration or cooling system. A further turbine 12 is also driven by bleed air from one or more compressors of

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Price 3s.

the aircraft engines by means of a suitable connection (not shown) and this turbine 12 drives a fan 13 for a purpose to be described.

5 The bleed airstream 4, having been joined by the recirculating system at 14 mixes with the recirculating air and passes through a heat exchanger 15 cooled by the abovementioned cooling system. The airstream 16, from the heat exchanger 15, then enters the aircraft enclosure.

10 Air is withdrawn from the enclosure in a stream 17, and is split into two streams 18 and 19. The stream 18 passes directly (and through such valve control as may be appropriate) to the recirculating fan 9 and back to the enclosure by way of the heat exchanger 15. The other stream 19 is sucked through a carbon dioxide extractor 24 and a deodoriser 20 by the circulating fan 13 before returning to the enclosure by way of the fan 9 and heat exchanger 15. The carbon dioxide extractor may be of any desired type and could, for example, use lithium hydroxide to absorb the carbon dioxide. This extractor will reduce the amount of flushing air necessary. The deodoriser may be of any desired type, such as a chemical extraction unit using activated charcoal.

30 It will be noted that only a part of the recirculated air passes through the deodoriser 20, and this assists in reducing power losses, as it has been found that the passage of all the air through the deodoriser is not necessary to keep the odour level in the recirculated gas acceptable.

35 The cooling system for the recirculated air is of known form, and comprises the aforementioned heat exchanger 15 with its associated expansion valve 15A and compressors 40 10 and 11, and a condenser 21 and subcooler 22 with its associated expansion valve 22A. The system shown works on a closed circuit refrigeration system of the compression, condensation and evaporation type. Condensing of the refrigerant is carried out in the condenser 21 by means of a heat exchanging arrangement with air or fuel feed as indicated at 23.

45 Various modifications may be made to the above described air conditioning system without departing from the scope of the invention; as defined by the appended claims. For example, the turbines 7, 8 and 12 may be replaced by electric motors, either collectively

or individually. Alternatively, the turbines could be driven by ram air derived outside the aircraft. 55

The cooling system shown may be replaced by other cooling systems such as any suitable air cycle system. Such a system could incorporate a "boot strap" arrangement whereby the air supply from the engine compressor passes through a primary cooler, and is compressed by the compressor in a cold air turbine unit, and then passes to the turbine. The air entering the turbine converts heat energy into work by making the turbine drive the compressor which causes a reduction in air temperature through the turbine. Heat gains caused by the action of the compressor are cancelled out by passing through a heat exchanger before entering the turbine. 60 65 70

If desired the carbon dioxide extractor 24 may be omitted. Dehumidifying means may also be provided at an appropriate point in the recirculation system, e.g. in series with or incorporated with the deodoriser 20, or with a carbon dioxide extractor unit if such be present. 75

#### WHAT WE CLAIM IS:—

1. An air conditioning system for an enclosure of an aircraft comprising a first conduit means for conducting ambient air to the enclosure, heat exchange means for cooling the air passing to the enclosure, the heat exchange means comprising part of the circuit of a cooling system, a second conduit means for recirculating air from the enclosure and conjoining with the first conduit means upstream of the heat exchange means, a third conduit means branching from and returning to the second conduit means and providing means for removal of odours and carbon dioxide from a portion of the air recirculating through the second conduit, a first fan means in the second conduit for urging recirculation of the air, and a second fan means in the third conduit means to urge therethrough the portion of the air. 80 85 90 95

2. An air conditioning system as claimed in Claim 1, wherein the ambient air supplied is bleed air from the aircraft engine air supply. 100

3. An air conditioning system for an enclosure of an aircraft substantially as described with reference to the accompanying drawing.

For the Applicants,  
L. H. HAYWARD.

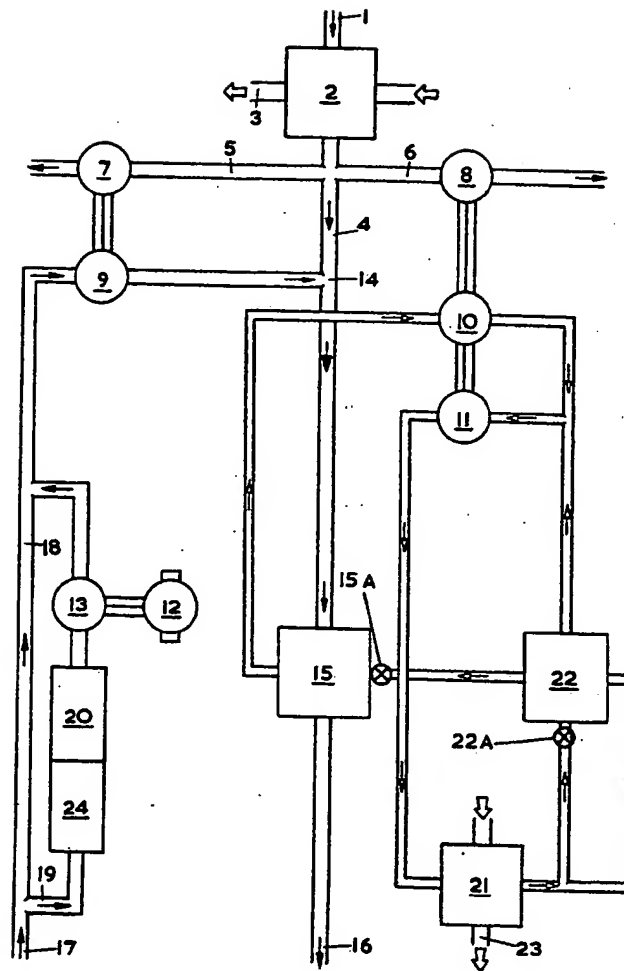
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COMPLETE SPECIFICATION

1 SHEET

*This drawing is a reproduction of  
the Original on a reduced scale*



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